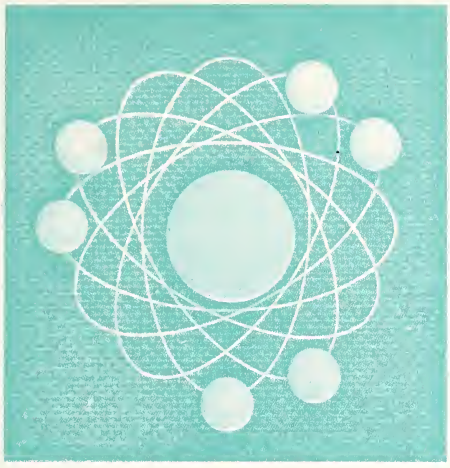
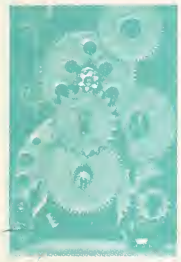
Teacher's Manual for Use with

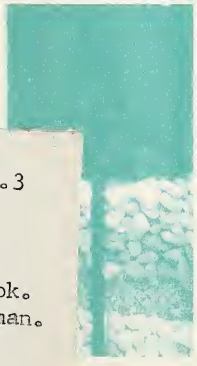
Activities for Exploring Matter and Energy

Exploring Living Things

Exploring Earth and Space







Teacher's Manual for Use with

Activities for:

Module 1 Exploring Matter AND Energy

Module 2 Exploring Living Things

Module 3 Exploring Earth AND Space

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Teacher's Manual
for Use with

ACTIVITIES
for
EXPLORING MATTER AND ENERGY
EXPLORING LIVING THINGS
EXPLORING EARTH AND SPACE

TEACHING SCIENCE WITH ACTIVITIES

The Process of Science

The study of science is intimately bound up with the process of science—that is, the firsthand observation of or experimentation with natural phenomena. Through activities which require observation and experimentation, students obtain answers to questions, discover principles, and see relationships which enable them to understand science concepts. Thus, the process method of studying science provides students with both a meaningful experience and the satisfaction of discovery.

Each activity in the Student Activity Book is introduced by a question. The question is intended to motivate the students to find out about some aspect of the material they are studying in the text. Then a short paragraph or two provide the background necessary for the activity. After writing down what they think the outcome of the activity will be, the students begin doing the activity—collecting data and answering questions. From the time an activity is started until it is completed, students are personally involved in a series of activities which constitute the process of science. The activities not only lead to answers, but they also provide opportunities to record and use data, to communicate with other students, to compare data, to draw inferences, and to make applications.

The Teacher's Role

The Student Activity Book provides activities in which students become personally involved with the processes of science. The process method of studying science would not lead to discovery if the teacher merely gave the answers to the students. The teacher's role should be that of a resource person. The teacher should let the written material guide the activity. (This does not mean the teacher is to renounce responsibility for discipline and the care of property.) As a resource person, the teacher may stimulate or initiate action, show interest in and enthusiasm for the activities going on, and encourage stragglers. The teacher should be a sympathetic observer and listener, but not a director.

The teacher should encourage students to record their own results, their own observations, and their own inferences, regardless of whether or not the data recorded is like that of their classmates. By working independently, students grow in the ability to observe, relate, record, and apply information and data.

The teacher should keep in mind that students vary in ability, both intellectual and manipulative. The teacher must recognize that the same activity performed by students of varying ability may have diverse outcomes and that observations may be described in a wide variety of terms. Through nonjudgmental discussion, the teacher should let each student participate and enjoy maximum self-satisfaction.

Using the Teacher's Manual

In the teacher's manual, the response given to many of the questions is an example of the probable answer from a student, indicated by (PA). In some activities, the data cannot be anticipated. These parts are indicated by the phrase "Student's data." In many activities, the data of various students are likely to differ. These parts of the activities might be marked as follows: Student's data (responses, answers) will vary with the procedure (materials) used.

EXPLORING MATTER AND ENERGY

Activity 1. FOOLING YOUR SENSES, pp. 3–6

Purpose

The purpose of this activity is to have students use their senses in various situations. The situations are such that students find out that their senses are not always accurate.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, using space-time relationships, inferring

Preparation

You may wish to ask various students to bring in some of the materials needed for the activity—orange juice, nondiet cola, apples, candy (such as mints or lemon drops), and plastic dishpans or washbasins. If you have large beakers (800 mL or 1000 mL) or large battery jars, you may wish to have the students use these beakers or jars instead of plastic dishpans or washbasins.

You should have some plastic cups or paper cups for the students to use, and you should also have a good supply of paper towels for the students to use in drying their hands.

Answers to Activity Review: Part 1

1. (PA) Before eating the candy, the apple tasted just as it normally tastes. After eating the candy, the apple seemed more sour than it did at first.
2. (PA) Before drinking the cola, the orange juice tasted just as it normally tastes. After drinking the cola, the orange juice seemed more sour than it did at first.
3. (PA) Yes, the sense of tasting was fooled. It seems that after tasting very sweet substances, other substances taste more sour than they normally taste.

Data Collected: Part 2

Examples of data that students might obtain in Part 2 may be found in the following table.

Drawing	Question	Column 1 How It Appears	Column 2 How It Really Is
1	Which is greater, the width of the hat or its height?	*(PA) The hat looks higher than it is wide.*	*The width is greater.*
2	Which is longer, AB or XY?	*(PA) AB looks longer.*	*They are the same.*
3	Which is longer, AB or BC?	*(PA) AB looks longer.*	*BC is longer.*
4	Is line AB a straight line?	*(PA) AB is not straight.*	*AB is straight.*
5	Which is longer, A or B?	*(PA) A looks longer.*	*B is longer.*
6	Which circle is larger, A or B?	*(PA) B looks larger.*	*They are the same.*
7	Which square is smaller, A or B?	*(PA) A looks smaller.*	*They are the same.*
8	Which ladder is longer, A or B?	*(PA) B looks longer.*	*A is longer.*

Answers to Activity Review: Part 2

(PA) No, the eyes would not normally be deceived as often as they were in this activity. The drawings in this activity are especially designed to mislead the sense of seeing.

Answers to Activity Review: Part 3

1. Student's data

2. Student's data

3. (PA) Yes, having one ear covered did affect the ability of the person to determine the direction from which sound came. With one ear covered, the person could not indicate the direction of the sound as accurately as when both ears were used.

4. (PA) One explanation of why using two ears was different is that sound coming from a certain direction affects two ears differently than one ear. The brain has learned through repeated experiences how to interpret the differences. When one ear is covered, the brain does not get enough information to make accurate interpretations.

5. (PA) Yes, on the basis of observations, it seems that the sense of hearing can be fooled. The sense of hearing seems to be fooled more often when only one ear is detecting the sound.

6. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 2. HELPING YOUR SENSES, pp. 7–8 02

Purpose

The purpose of Activity 2 is to have students use some chemicals and then a microscope to help their senses identify various substances.

Processes Utilized

Observing, comparing, recording, using space-time relationships, inferring.

Preparation

On the day before beginning the activity, make sure the materials needed are available. If you do not have foodstuffs such as sugar and table salt in the laboratory, you may wish to have students bring them from home.

Before beginning the activity, it might be a good idea for you or a student assistant to check the watch glasses, microscopes, and microscope slides for cleanliness. Be sure to clean them or have them cleaned if they need cleaning.

Data Collected: Part 1

An example of a student's data for the immediate effects and the effects after five minutes may be found in the table at the end of the teacher's manual material for Activity 2.

Answers to Activity Review: Part 1

1. (PA) Yes, sugar dissolves in water, and sugar dissolves slowly in alcohol.

2. (PA) When water was added to the anhydrous copper sulphate, the anhydrous copper sulphate and the water turned blue.

3. (PA) No, alcohol did not have any effect on the anhydrous copper sulphate (unless the alcohol had been diluted with water).

4. (PA) Yes, the plaster of paris behaved differently in water than it did in alcohol. The plaster of paris formed a paste and then hardened in water. The plaster of paris did not mix with alcohol.

5. (PA) The differences noticed five minutes after water was added to the sugar and anhydrous copper sulphate that were not noticed immediately were that the solids were more completely dissolved. After five minutes, the difference in the plaster was that it was beginning to harden.

(PA) There were no differences after five minutes elapsed that were not noticed immediately after alcohol was added to the three substances.

6. (PA) Yes, one of the substances used in the activity can be used to find out whether or not an unknown liquid is water. If you put a drop of the unknown liquid on some anhydrous copper sulphate and the copper sulphate turns blue, the liquid contains water.

Data Collected: Part 2

The following drawings and answers are examples of sketches and descriptions students might make.

(PA) Each grain of sugar has some flat sides and some irregular sides. Each grain seems to be part of what was a large sugar crystal.

Sugar Salt

(PA) Each grain of salt is a small, cube-shaped crystal. In some cases the corners of the grains are somewhat rounded.

Answers to Activity Review: Part 2

1. (PA) The differences between sugar and salt are that each salt grain has a cubic shape and each sugar grain has an irregular shape.

2. (PA) Other substances that have easily identifiable crystal shapes are quartz and mica.

3. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Sample	Solvent	What Happens Immediately	What Happens in 5 Minutes
Sugar	Water	*Begins to dissolve*	*Dissolves*
	Alcohol	*Begins to dissolve*	*Dissolves*
Anhydrous Copper Sulphate	Water	*Turns blue*	*Begins to dissolve*
	Alcohol	*Nothing*	*Nothing*
Plaster of Paris	Water	*Forms a paste*	*Hardens*
	Alcohol	*Nothing*	*Nothing*

4/9 Activity 3. DETERMINING DENSITY, pp. 9–12

Purpose

The purpose of this activity is to enable students to learn how to determine the density of various forms of matter and to practice determining density by finding the densities of several substances.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, predicting, inferring

Preparation

Before beginning this activity, you may wish to have the students bring regularly shaped wooden blocks to class. These blocks could come from the industrial-arts class in school or they could come from home workshops.

Data Collected: Parts 1, 2, and 3

The data in each part will vary with the equipment and with the samples used.

Answers to Activity Review: Part 1

1. The density that was determined for the wooden block was less than one.

2. In this part of the activity, the information needed to compute the density was the mass and the volume of the sample.

Answers to Activity Review: Part 2

1. (PA) Yes, the water-displacement method can be used to determine the volume of a granular substance such as sand or gravel. In fact, the water-displacement method should be used because the air spaces between the grains should not be counted as part of the volume of the substance.

2. (PA) The water-displacement method cannot be used for a substance that dissolves in water (salt or sugar) or a substance that reacts with water (seltzer tablet).

Answers to Activity Review: Part 3

1. The density of alcohol was less than the density of water.

2. (PA) It was found that the density of alcohol was close to 0.81 g/cm^3 but not exactly that amount. The difference could be due to inaccurate measuring or to differences in temperature.

Answers to Activity Review: Parts 1, 2, and 3

1. In each part of the activity, the information needed was the mass and the volume of the sample.

2. (PA) No, the same method was not used in determining the mass of each sample. If the sample was a solid, it was just placed on the balance and measured. If it was a liquid, the mass of the container had to be subtracted from the mass of the sample and container.

3. (PA) No, the same method was not used each time to determine the volume. First, the volume was measured by finding the length, width and height and then multiplying them. Second, the volume was measured by water displacement. Third, the volume of the liquids was measured directly with a graduated cylinder.

4. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 4. BUOYANCY OF WATER, pp 13-14

Purpose

The purpose of this activity is to have students determine the buoyancy of water.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, inferring

Preparation

On the day before beginning the activity, make sure that the materials needed for the activity are available. Be sure that the piece of iron and the wooden block are each small enough to fit into the overflow can. If overflow cans are not available, large beakers may be used. If catch buckets are not available, any small container may be used.

Data Collected

The data which students might obtain will depend on the size of the wooden block and piece of iron used.

Answers to Activity Review

1. (PA) The piece of iron and the wooden block appeared to lose weight when they were placed in the water.
2. (PA) The weight of the piece of iron was greater than the weight of the water displaced.
3. The piece of iron sank.
4. (PA) The weight of the wooden block was the same as the weight of the water displaced.
5. The wooden block floated.
6. (PA) The apparent loss of weight for each object was the same as the weight of water displaced for each object.
7. (PA) The buoyant force of water is equal to the weight of the water displaced.
8. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 5. MEASURING WORK, pp. 15-16 (3)

Purpose

The purpose of this activity is to increase the students' understanding of work through computing the amount of work done in several hypothetical situations.

Processes Utilized

Comparing, recording, using numbers, using space-time relationships

Data Collected

Students' data concerning work done should be the same as shown in the table below.

Situation A	*90 newton-metres*
Situation B	*600 newton-metres*
Situation C	*400 newton-metres*
Situation D	*45 newton-metres*

Answers to Activity Review

1. (PA) The most force was used in situation (400 N).
2. (PA) The object was moved the greatest distance in situation *B* (30 m).
3. (PA) The most work was done in situation (600 newton-metres).
4. (PA) The least work was done in situation (45 newton-metres).
5. (PA) Sometimes less work is done in a situation in which more force is used than in a situation in which less force is used because force is only one of the factors in determining the amount of work done. The other factor that determines the amount of work done is the distance through which the force acts. Thus, more work might be done by a small force acting through a great distance than by a much greater force acting through a very short distance.

Activity 6. UNBALANCED FORCES, pp. 17-18

Purpose

The purpose of this activity is to enable students to discover how friction affects the amount of effort required to set an object in motion.

Processes Utilized

Observing, comparing, recording, predicting

Preparation

You may wish to have students use a weighted box instead of a brick. If you do not wish to go outside, you might use a board covered with sandpaper as the rough surface.

Data Collected

The data collected will vary with the weight of the brick and the roughness of the surface.

Answers to Activity Review

1. Answers will vary depending upon the weight of the brick or other object used.
2. Answers will vary depending upon the weight of the brick and the roughness of the surface.
3. (PA) There was more friction between the brick and the rough surface. The rough surface is much more likely to catch and pull on the surface of the brick.
4. (PA) Some ways that you might lower the amount of force needed to make an object move are to slide it over a very smooth surface, to move it over an oiled surface, and to place rollers under the object.
5. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 7. THE THIRD LAW OF MOTION, pp. 19-20

Purpose

The purpose of this activity is to enable students to gain a better understanding of the third law of motion.

Processes Utilized

Observing, comparing, recording, measuring, predicting, inferring

Preparation

This activity should be done either outdoors or in the school gym. Also, if the school does not have any, you will probably have to ask the students to bring their own roller skates.

Data Collected

The data which students record will vary with the mass of each student and the force of the throw.

Answers to Activity Review

1. Answers will vary depending upon the mass of the student on skates and how hard the ball was actually thrown.
2. Answers will vary depending upon the mass of the student and how hard the ball was thrown.

3. (PA) A rocket will have greater thrust when the hot gases are pushed out with great force. The greater the force pushing on the gases, the greater the force pushing the rocket forward.

4. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 8. PRINCIPLES OF FLIGHT, pp. 21-26

Purpose

This activity is intended to help students gain a better understanding of some of the principles of flight. To gain an understanding of these principles, students construct models to observe how a wing creates lift and how different parts of an airplane function to control the movement of the airplane during flight.

Processes Utilized

Observing, comparing, recording, measuring, using space-time relationships, inferring

Preparation

Before beginning this activity, you may wish to obtain enough file folders (preferably old ones) to go around. You may wish to use other pieces of cardboard if you have any. Also, balsa wood is sometimes difficult to obtain. You could use pieces of paneling instead of balsa wood for this activity. However, the mass of the paneling will be much greater than the balsa wood.

Data Collected: Part 1

Examples of data that students might obtain for the lift on the airplane wings they made are given in the following table.

Answers to Activity Review: Part 1

1. (PA) Wing shape *A* produced the greatest amount of lift.

2. (PA) Wing shape *D* produced the smallest amount of lift.

3. (PA) The distance across the bottom of wing shape *A* is equal to that of wing shape *D*. However, the distance across the top of wing shape *A* is much greater than the distance across the top of wing shape *D*.

4. (PA) The advantage that wing shape *A* has over the other shapes of wings is that wing shape *A* has a streamlined shape. Air flowing over the top of this wing smoothly joins the air flowing under the wing. The air above and behind the wing does not become turbulent.

5. (PA) The wing shapes *B*, *C*, and *D* create too much turbulence in the air as the air flows over the wing.

Data Collected: Part 2

2. When the rudder is bent to the left, the airplane turns to the left.

3. When the rudder is bent to the right, the airplane turns to the right.

5. When the left aileron is up and the right aileron is down, the airplane rolls to the left. That is, the left wing goes down and the right wing goes up.

6. When the right aileron is up and the left airleron is down, the airplane rolls to the right.

8. When the elevator is down, the nose of the airplane turns down.

9. When the elevator is up, the nose of the airplane turns up.

Wing Shape	Distance from Front to Back		Mass of Wire Stand and Wing (fan off)	Mass of Wire Stand and Wing (fan on)	Lift
	Top	Bottom			
A	*98 mm*	*89 mm*	*Student's data*	*Student's data*	*Student's data*
B	*104 mm*	*89 mm*	*Student's data*	*Student's data*	*Student's data*
C	*89 mm*	*89 mm*	*Student's data*	*Student's data*	*Student's data*
D	*91 mm*	*89 mm*	*Student's data*	*Student's data*	*Student's data*

Answers to Activity Review: Part 2

1. (PA) To turn to the right and go higher, the rudder should be turned to the right, the elevator should be raised, the right aileron should be raised, and the left aileron should be lowered.

2. (PA) To turn to the left and go lower, the rudder should be turned to the left, the elevator should be lowered, the right aileron should be lowered, and the left aileron should be raised.

3. (PA) If wings shaped like an airfoil had been used in this part of the activity, the airplane would have behaved more like a regular airplane because the airfoil shape would give the airplane some lift.

4. Each student's response will depend upon the expected outcome stated at the beginning of this activity.

Activity 9. THE SOURCES AND KINDS OF AIR POLLUTION, pp. 27-30

Purpose

The purpose of this activity is to increase an awareness in the students of the problem of air pollution. This purpose is accomplished by having students examine and analyze data concerning sources of air pollution.

Processes Utilized

Observing, comparing, using numbers, inferring, interpreting data

Answers to Activity Review: Part 1

1. Of the sources listed, motor vehicles are the source of the greatest amount of pollutants in the air.
2. Of the souces listed, refuse disposal is the source of the smallest amount of pollutants in the air.
3. Of the sources listed, carbon monoxide is the most abundant pollutant in the air.
4. Of the pollutants listed, oxides of nitrogen and particulates are the least abundant in the air.
5. Air pollution could be cut in half if only the pollutants from motor vehicles were stopped in some way.
6. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Answers to Activity Review: Part 2

1. (PA) Each graph shows that the amount of pollutant that is put into the air increases as the years pass if pollution-control devices are not used.
2. (PA) Each graph shows that pollution-control devices cut down the amounts of carbon monoxide and hydrocarbons at first. But then the amounts gradually increase after 1975.
3. (PA) The amounts of hydrocarbons and carbon monoxide are expected to increase after 1975 because of the greater number of motor vehicles that will be in use then. Each vehicle will produce less pollution, but there will be so many vehicles that the total amount of pollution will be greater.
4. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 10. FILTERING WATER, pp. 31-32

Purpose

Activity 10 is designed to help students understand how dirty water can be filtered as one of the steps in water treatment.

Processes Utilized

Observing, comparing, recording, inferring

Preparation

Before beginning this activity you may wish to make sure you have enough coarse gravel, fine gravel, coarse sand, fine sand, and charcoal. You may wish to have your students use a burette clamp to hold the funnel a bit more securely.

Data Collected

4. If a student had a good filter, the student might use statements such as the following to describe the filtrate that was obtained.

The water was clear and clean. It did not seem to have any mud in it.

Answers to Activity Review

1. (PA) The water was cleaner after passing through the layers of material in the funnel.

2. (PA) The layers of material in the funnel must have stopped the particles of mud from passing through.

3. (PA) The fine sand was probably the most effective material in filtering the muddy water because the sand in the filter now has mud in it. (You may wish to mention to your students that filters have to be cleaned if they are going to be used repeatedly.)

4. (PA) The same kinds of layers used in the funnel could also be used in filtration beds or filtration towers, but the layers would have to be much thicker.

5. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

EXPLORING LIVING THINGS

Activity 1. STUDYING A MICROHABITAT, pp 33-36

Purpose

The purpose of Activity 1 is to have students discover that microhabitats exist within larger macrohabitats. Students will also learn that the kind and number of organisms within a microhabitat are different from those of the macrohabitat because the environmental conditions within the microhabitat are different from those in the macrohabitat.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, inferring

Preparation

Before beginning this activity, try to locate suitable microhabitats on the school ground, in a nearby park, along a roadside, in an alley, or in a vacant lot. A suitable microhabitat might be found under a large stone or board, under a rotting log, on the bark at the base of a large tree, under a brush pile, in a culvert or a ditch, along a cinder path, under a refuse can, or on the shady side of the school steps. List the microhabitats you find, and use the list to assign or direct the students to microhabitats for study. Emphasize that a microhabitat is small—from a few square centimetres to something less than a square metre—and different from the macrohabitat. It is the differences between microhabitats and macrohabitats that students will be studying in this activity.

Answers to Activity Review: Part 1

1. Student's data.
2. Descriptions will vary depending upon the nature of the microhabitat.
3. Descriptions will vary depending upon the nature of the macrohabitat.
4. Responses will vary depending upon the microhabitat and the macrohabitat being studied.

Answers to Activity Review: Part 2

1. Descriptions will vary depending upon the nature of the microhabitat.
2. Responses will vary depending upon the microhabitat.
3. Responses will vary depending upon the microhabitat and the macrohabitat being studied.
4. Responses will vary depending upon the microhabitat and the macrohabitat being studied.
5. Answers might include such specimens as earthworms, centipedes, isopods, snails, beetles, toads, and salamanders.
6. Responses will very depending upon the microhabitat and the macrohabitat being studied.
7. (PA) In determining the kind and number of plants and animals in the microhabitat, amount of moisture seemed to be an important feature. Plants and animals that would dry out and die if exposed to direct sunlight and air were found in sheltered places. Plants and animals that were very resistant to drying out were found in dry, sunny places, subject to considerable exposure. Few plants and animals can live in both places.

Activity 2. COMPETITION AMONG PLANTS, pp. 37-38

Purpose

The purpose of this activity is to enable students to determine that plants compete for various important environmental factors such as light, moisture, minerals, and air.

Processes Utilized

Observing, comparing, recording, using numbers, using space-time relationships, inferring, interpreting data

Preparation

If dandelion or plantain plants are not available, then any other broad-leaved weed could be used.

Data Collected

Typical data indicating the circumference of a plantain or a dandelion plant and the number of grass plants in the circle are shown at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. (PA) When plantain or dandelion plants have been removed, the lawn had fewer grass plants. Plantain or dandelion plants crowd out much of the grass.

2. The number of grass plants on the grassy area would depend upon the area studied.

3. (PA) The average number of grass plants in circles with plaintain or dandelion plants was smaller than the number of grass plants in an average-sized circle without plantain or dandelion plants.

4. (PA) Yes, grass would grow in the area occupied by plantain and dandelion plants if the plantain and dandelion plants were not there. The grass would have all the essentials for growth if the plantain and dandelion plants were not there.

5. (PA) The environmental factors involved in the competition between grass and the dandelions or plantains were light, water, air, and minerals.

6. (PA) The broad leaves, long roots, thick stalks, and large size of dandelions and plantains are some structural factors that enable them to compete successfully with grass.

7. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Average
Circumference	*43 cm*	*46 cm*	*58 cm*	*43 cm*	*48 cm*	*51 cm*	*48 cm*
Number of Grass Plants	*4*	*6*	*5*	*1*	*2*	*6*	*4*

Activity 3. SUCCESSION IN AN AQUATIC MICROCOMMUNITY, pp 38-42

Purpose

The purpose of this activity is to enable students to observe the process of succession through the study of an aquatic microcommunity. In addition, the students will have an opportunity to learn that microscopic populations develop, grow, and die out as the environment changes.

Processes Utilized

Observing, comparing, recording, communicating, inferring, interpreting data

Preparation

Before beginning this activity, you or a student assistant should make sure that the microscopes are in good working order and make certain that the lenses are clean. Also, make certain that microscope slides, coverslips, and medicine droppers are clean. In addition, you or a student assistant should assemble all available reference materials concerning micro-organisms.

Data Collected

An example of a student's record sheet may be found at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. (PA) The first day after the jar was prepared, there was evidence of organisms.

2. Students' answers will vary considerably. (The answers given here for questions 2 and 3 are based on the information in the sample record sheet and represent only the names of organisms that might possibly be found in the students' data. Such answers are not to be thought of as typical answers nor as typical organisms that could be found in a particular stage of succession.) In the first recorded observation the most abundant kind of organism was bacteria. (Note: Bacteria will be seen only if very good microscopes are available and if students have learned to use them very well.)—In the second recorded observation, the most abundant was bacteria.—In the third recorded observation, the most abundant was *Nictotherus*.—In the fourth recorded observation, the most abundant was organism *A*.—In the fifth recorded observation, the most abundant was *Euglena*.—In the sixth recorded observation, the most abundant was algae.

3. Of all the kinds of organisms seen in the first recorded observation, the least abundant kind of organism was diatoms.—In the second recorded observation, the least abundant was *Vorticella*.—In the third recorded observation, the least abundant

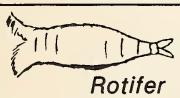
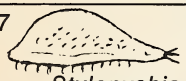
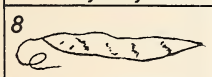
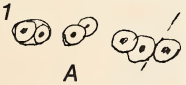
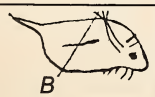
was algae.—In the fourth recorded observation, the least abundant was organism *B*.—In the fifth recorded observation, the least abundant was *Vorticella*.—In the sixth recorded observation, the least abundant was *Stylonychia*.

4. (PA) The relative abundance of an organism might be explained by the environmental conditions, particularly the available food supply.

5. (PA) A decrease in the relative abundance of an organism might be explained by the food supply running out or by the organism's having served as the food supply for another organism.

6. (PA) Yes, some of the organisms disappeared during the course of the activity. The kinds of organisms that seem to have disappeared were *Paramecium, Nictotherus*, rotifers, *Vorticella*, and worms.

7. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Kind of Organism	Date *May 5* Abundance	Date *May 8* Abundance	Date *May 12* Abundance	Date *May 15* Abundance	Date *May 19* Abundance	Date *May 22* Abundance
1  Bacteria	Many	Very many	Many	Some	Few	Few
2  Paramecium	Few	Some	Many	Some	Few	
3  Nictotherus	Few	Many	Very many	Few		
4  Diatoms	Few	Some	Some	Some	Some	Few
5  Rotifer		Few	Many	Some	Few	
6  Vorticella		Few	Many	Some	Few	
7  Stylonychia			Some	Many	Some	Few
8  Euglena			Some	Many	Very many	Many
9  Worm			Few	Few		
10  Algae			Few	Many	Many	Very many
11  A			Many	Very many	Some	Few
12  B				Few	Some	Many

Purpose

The purpose of this activity is to simulate the work of an archaeologist in interpreting data that may be found at an archaeological site.

Processes Utilized

Observing, comparing, recording, inferring

Preparation

Discuss with your students the importance of interpretation in the study of archaeology. After an excavation is made, an archaeologist must interpret what an artifact reveals about the civilization that it represents.

Data Collected

The data that the students record in the tables will depend upon what kinds of civilizations are chosen by the groups and by the interpretations made by each group. Examples of how a group of students, say Group 2, might fill out Tables 1, 2, and 3 are given in the tables at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. Answers will vary depending upon the artifacts chosen.
2. Answers will vary depending upon the artifacts chosen.
3. Answers will vary depending upon the civilizations used.
4. (PA) Archaeologists often have the problem of deciding where to dig and how to dig. They also have the problem of finding enough artifacts to help them interpret properly the civilization they are dealing with. Sometimes, they cannot dig where they would like to because the property is being used for some other purpose.
5. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Answers to Optional Activity

2. Since fossils of camels and rhinoceroses were found at deeper levels in North America, scientists say that camels and rhinoceroses first appeared in North America and later crossed over to Asia. Since fossils of bison, elephants, and mastodons were found at deeper levels in Asia, scientists say that these animals first appeared in Asia and later crossed over to North America. To find out when the continents were connected, scientists could date the fossils on both sides of the ocean to determine periods when certain fossils were only on one side and a later period when they were on both sides. Sometime between those two times would be the time when the animals were able to walk across from one continent to the other.

TABLE 1. PRESUMED CHARACTERISTICS

Site	Time	Occupation	Beliefs	Other Details
1	*Ancient*	*Hunter*	*Worshipped the sun*	*Stone tools*
2	*(No data, since this represents data collected by Group 2)*			
3	*Modern*	*?*	*Some religion*	*Used glass and aluminum containers*
4	*Ancient*	*Fisher*	*?*	*Bone tools*
5	*Future*	*?*	*?*	*Traveled in space* *Used nuclear power*
6	*Ancient*	*?*	*?*	*Lived in caves*

TABLE 2. CLASS TALLY FOR BEING INTERPRETED CORRECTLY

Group	Time	Occupation	Beliefs	Other Details	Total
1	///	//	///	//	10
2	~~////~~	///	////	/	13
3	/	/	/	/	4
4	////	////	///	~~////~~	16
5	//	//	//	//	8
6	///	///	///	///	12

TABLE 3. GROUP TALLY FOR MAKING CORRECT INTERPRETATIONS

Group	Time	Occupation	Beliefs	Other Details	Total
1	/	/	/	/	4
2	*(No data, since this represents data collected by Group 2)*				
3	/		/		2
4	/	/	/	/	4
5	/				1
6	/	/		/	3
		Grand Total for Making Correct Interpretations			14
		Total for Being Interpreted Correctly (from Table 2)			13
		Final Score			27

Activity 5. RESPONSIVENESS, pp. 47-50

Purpose

The purpose of this activity is to enable students to find out how a certain kind of living organism responds to stimuli of different kinds.

Processes Utilized

Observing, comparing, using space-time relationships, inferring

Preparation

Many of your students may never have taken a close look at an isopod. So before beginning this activity, you may wish to use a chart or other visual device to show your students the structure of an isopod.

You will need quite a few isopods to have your students do this activity. They may be purchased from

a biological supply house, or you may wish to have students collect them if you do not live in a dry climate. Have students look for them under rocks, under leaves, and under or near any rotting wood.

In order to keep isopods for any length of time, place them in a container to which you have added a one- or two-centimetre layer of peat moss. Small pieces of potatoes and/or carrots should also be placed in the container. A piece of wet-cotton or sponge should be placed in with the isopods and care should be taken that they get enough air without allowing them to escape.

Calcium chloride becomes wet after it is exposed to air for a long period of time, so make sure the calcium chloride students use is dry. If your supply has become moist, you can dry it out by putting it in a hot oven.

Answers to Activity Review: Part 1

1. (PA) The usual response of the isopods to being touched a great deal was to curl up into a ball.
2. (PA) The response to being touched was the same each time.
3. (PA) Isopods do not have any means of defense other than curling up when they are touched. When curled up, isopods get some protection from their exoskeleton.
4. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Answers to Activity Review: Part 2

1. (PA) When the can was turned toward the light, the isopods moved away from the light.
2. (PA) When the bright lamp was directly above them and a rock was placed in the can, the isopods moved under the rock.
3. (PA) The response of the isopods to light is negative—that is, they move away from the light.
4. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Answers to Activity Review: Part 3

1. (PA) The isopods in the can that contained the moist cotton were fairly active.
2. (PA) The isopods in the can that contained the calcium chloride were not very active.
3. (PA) The response of isopods to moisture is to be more active in moist conditions than they are in dry conditions.
4. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 6. THE ANT—A COLONIAL INSECT, pp. 51-52

Purpose

The purpose of this activity is to enable students to observe an ant colony, to see the ways ants behave in a colony and to gain an understanding of the advantages to the ants of living together in a colony.

Processes Utilized

Observing, comparing, recording, inferring

Preparation

Two pieces of glass about 15 cm x 25 cm, some sand, and some putty could be used to make an ant farm. The pieces of glass should be separated at the edges by the putty. The layer of putty should be at least one centimetre thick and tight enough to hold sand. Some masking tape or adhesive tape should be used at the corners to hold the ant farm together. To hold the ant farm upright, cut a slot the thickness of the ant farm in two thick pieces of wood. Whether you use ants obtained from a scientific supply company or ants that students have collected, great care should be taken that the ants do not have an opportunity to escape. You may want to place the ant farm in a large enough container so that it may be surrounded by water. Water should not be allowed to get into the ant farm; however, if water surrounds it, the water will act as a barrier so that the ants do not escape.

Answers to Activity Review

1. (PA) The ants began gathering around the honey. They were eating it and also carrying some of it to the queen and the honey ants.
2. (PA) The ants began gathering around the honey as before, but they did not begin to do so right away.
3. (PA) The reaction to the food was quicker when the food was placed near the centre of activity.
4. (PA) One advantage to living in a colony is that no ant has to do all the different things that need to be done. Another is that in the colony a

certain kind of work can be done more efficiently by certain kinds of ants. The work can then be shared for the benefit of everyone.

5. (PA) One disadvantage to living in a colony might be that the ants would be easily found by their enemies because they live together in large groups. Another is that a disease could easily spread throughout the colony because the ants live so close together.

6. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 7. THE LIFE CYCLE OF A MOSQUITO, pp. 53-54

Purpose

The purpose of this activity is to enable students to observe the life cycle of the mosquito. They should see the egg, larva, pupa, and adult of a mosquito.

Processes Utilized

Observing, recording, using space-time relationships, inferring

Preparation

Mosquitoes may be collected in the spring, summer, and fall by using sweep nets in damp forests or near lakes, rivers, ponds, and streams. This activity should not be planned for a time of year when mosquitoes are not available.

Have your students change the fruit and meat in the jar every 2 or 3 days. They should wear gloves as they change the food, and the insects should not be allowed to escape.

Data Collected

The following data are samples of data similar to that which students might record. The data will vary somewhat with the kind of mosquito and the season of the year.

Answers to Activity Review

1. (PA) It took 3 days for the first eggs to appear.

	Eggs	Larvae	Pupae	Adults
Number of Days Until Observed	*3*	*6*	*13*	*16*

2. (PA) It took 3 more days for the first wrigglers (larvae) to appear.

3. (PA) It took 7 more days for the first tumblers (pupae) to appear.

4. (PA) It took 3 more days for the first adults to emerge.

5. (PA) About 30 days after the mosquitoes became adults, they laid eggs.

6. (PA) No, the life cycle of a mosquito is not very long. My data indicate that the life cycle lasts about a month and a half. (There are many exceptions to this. Some mosquitoes spend the winter as eggs, for example. Also, the time between generations in some mosquitoes may be as little as 3 weeks.)

7. (PA) Since mosquitoes carry diseases, it is a good idea for people to know how to control them.

8. (PA) In order to control mosquitoes, people should not allow water to collect in garbage dumps or in any containers left lying outside. Also, places where mosquitoes breed may have to be sprayed with insecticides.

9. Each student's response will depend upon the expected outcome stated at the beginning of this activity.

Activity 8. HATCHING BRINE-SHRIMP EGGS, pp. 55-58

Purpose

The purpose of this activity is to enable students to find out how variations in temperature and in the concentration of salt affect the hatching of brine-shrimp eggs.

Processes Utilized

Observing, comparing, recording, inferring, predicting

Preparation

Before the students begin this activity, you will

need to prepare a sufficient quantity of a 3% salt solution and of a 10% salt solution. To make a litre of a 3% salt solution, dissolve 30 g of salt in 970 g of water. A litre of 10% salt solution can be made by dissolving 100 g of salt in 900 g of water. Brine-shrimp eggs can be purchased at most pet shops or from a biological supply company.

Data Collected: Part 1

An example of possible data that students might record is given in Table 1 at the end of the teacher's manual material for this activity.

Answers to Activity Review: Part 1

1. (PA) Yes, test tube *2*
2. (PA) Test tube *2*—(PA) Test tube *2* (A few eggs may hatch in test tube *1*.)
3. (PA) Test tube *2*
4. (PA) Few or no eggs hatched in test tube *1*.
5. (PA) The more favorable temperature for the hatching of brine-shrimp eggs seemed to be room temperature, that is, 22 °C.
6. Each student's answer will depend on the expected outcome stated at the beginning of the activity.

Data Collected: Part 2

An example of possible data that students might record is given in Table 2 at the end of the teacher's manual material for this activity.

Answers to Activity Review: Part 2

1. (PA) Yes, test tube *4*
2. (PA) Test tubes *3* and *4*—(PA) Test tubes *3* and *4*
3. (PA) Test tube *4*
4. (PA) No eggs hatched in test tube *5*.
5. (PA) The 3% concentration seemed to be more favorable for the hatching of brine-shrimp eggs.
6. (PA) The 10% concentration seemed to be less favorable for the hatching of brine-shrimp eggs.
7. (PA) The lower concentration of salt resulting from a heavy rainfall would probably result in fewer eggs hatching.
8. (PA) The higher concentration of salt resulting from the evaporation of water would probably result in fewer brine-shrimp eggs hatching.
9. Each student's answers will depend upon the expected outcomes stated at the beginning of the activity.

TABLE 1.

Day	Test Tube	
	1—Refrigerator Temperature 5° C	2—Room Temperature 22° C
1	*None*	*A few*
2	*None*	*Many*
3	*None*	*Many*

TABLE 2.

Day	Test Tube		
	3—No Salt	4—3% Salt Solution	5—10 Salt Solution
1	*None*	*A few*	*None*
2	*A few*	*Many*	*None*
3	*A few*	*Many*	*None*

Activity 9. TESTING FOR VITAMIN C, pp. 59-62

Purpose

The purpose of this activity is to acquaint students with a method of testing for the relative amounts of vitamin C in foods and to compare the vitamin C content of various materials with that of fresh orange juice.

Processes Utilized

Observing, comparing, recording, using numbers, communicating, inferring

Preparation

In addition to the usual laboratory materials such as test tubes, beakers, and so on, you will need a variety of foods and beverages, including oranges, for this activity. If each student brings one item, you will have plenty of materials and no one person will have a great expense. The materials to be tested should be decided upon a day or two before the activity is to be done. You and the class may wish to add to the suggested list of materials to be tested.

If the testing liquid is sensitive enough—that is, if the iodine solution and starch are present in small enough amounts—only very small amounts of the juices and liquids to be tested are needed.

Data Collected

Examples of possible data students might record are given in the table. Actual data cannot be predicted.

Answers to Activity Review

1. (PA) Five drops of orange juice were needed to cause the color of the testing liquid to disappear. (This amount will vary greatly with the concentration of the juice and the strength of the testing liquid.)
2. (PA) The green pepper liquid and the dissolved vitamin C tablet required fewer drops than the number recorded for orange juice.
3. (PA) The materials that required more drops than the number recorded for orange juice to cause the color to change were lime juice and grapefruit juice.
4. (PA) The materials that did not cause the color to change were wheat germ oil and milk. (Although wheat germ and milk contain many vitamins and minerals, they do not contain very much vitamin C, if any.)
5. (PA) A vitamin C tablet would supply a person with the most vitamin C. Green peppers, orange juice, Hi-C, Kool-Aid, lime juice, lemon juice, and grapefruit juice are also sources of vitamin C. Wheat germ oil and milk would supply either no vitamin C or very little vitamin C.
6. (PA) The materials that contained added vitamin C compared very well with the fresh orange juice. In fact, these materials were equal to orange juice in vitamin C content.
7. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Material Being Tested	Number of Drops
Orange Juice	*5*
Lemon Juice	*5*
Lime Juice	*7*
Grapefruit Juice	*6*
Green Pepper Liquid	*3*
Wheat-Germ Oil	*no change*
Hi-C Drink	*5*
Kool-Aid Drink	*5*
Milk	*no change*
Dissolved Vitamin C Tablet	*1*

Activity 10. PHYSICAL ACTIVITY AND CARBON DIOXIDE, pp. 63-64

Purpose

The purpose of this activity is to enable the students to discover the relative amounts of carbon dioxide in exhausted air before and after physical activity. Then, students can make an inference about the effect physical activity has on the production of carbon dioxide in a person's body.

Processes Utilized

Observing, comparing, recording, measuring, using numbers, inferring, interpreting data

Preparation

In this activity, the students will need a quantity of 0.04 percent NaOH (sodium hydroxide) solution for measuring a chemical change. You or a student assistant should prepare the solution by first weighing 0.4 g of NaOH. Dissolve the NaOh in 1 L of distilled water. Cap the container to prevent evaporation, and label its contents by using a glass-marking pencil.

Answers to Activity Review

1. Student's data—Student's data
2. Student's data cannot be anticipated. However, the time required for a color change should be less for flask *B* than for flask *A*. (PA) The difference in amount of time required for a color change indicates that the amount of carbon dioxide in flask *B* was greater than in flask *A*.
3. (PA) Because there was more carbon dioxide in my breath after exercising, the production of carbon dioxide in the cells of my body must have increased during exercise.
4. (PA) One can infer from the increase in carbon dioxide production that food materials are used faster during exercise than during rest.
5. (PA) I think that more oxygen is needed during exercise than during rest. Since the carbon dioxide production increases during exercise, more oxygen must be used up. That's why a person breathes faster and deeper during exercise.
6. (PA) Muscle cells furnish energy for movement. So in this activity, muscles cells were producing the carbon dioxide that changed the solution from red to colorless.

Activity 11. RATE OF HUMAN HEARTBEAT, pp. 65-68

Purpose

By doing Activity 11, students can become aware of how the rate of a person's hearbeat varies as the activity of that person changes.

Processes Utilized

Observing, comparing, recording, using numbers, communicating, inferring, formulating a hypothesis, interpreting data

Preparation

If stopwatches or a classroom clock with a second hand are not available, you might keep time for the entire class using one stopwatch. In that case, have all teams work simultaneously on the same procedure. You might wish to take the pulse of the student as a demonstration.

Data Collected

Data similar to that which students might record for the individual rate of heartbeat per minute and for the class averages for rate of heartbeat per minute can be found in the tables at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. (PA) There was considerable variation in the rates of heartbeats while the students were at rest.
2. (PA) The average rate of heartbeat for boys at rest was less than the average rate of heartbeat for girls at rest.
3. (PA) The range was narrower for the boys than for the girls.
4. (PA) Standing at attention induces a muscular strain. Such a strain causes an increased need for oxygen and for the removal of carbon dioxide. (Carbon dioxide in the blood acts as a stimulant to the heart, making it beat faster.)
5. (PA) During breath holding and vigorous exercise, the rate of heartbeat increased over the rate of heartbeat at rest. The greater increase came after vigorous exercise.
6. (PA) When the subject breathed deeply, the rate of heartbeat decreased.
7. (PA) The subject's heartbeat increased most after vigorous exercise. After vigorous exercise, the rate of heartbeat increased due to an increase in the carbon dioxide content of the blood.
8. (PA) Yes, the rates of heartbeat increased for boys and for girls as the subjects held their breath and engaged in vigorous exercise.
9. (PA) Each student's response will depend upon the expected outcome stated at the beginning of this activity.

TABLE 1.

Tests	First Subject Sex *Male*	Second Subject Sex *Female*
1. At Rest	*70*	*75*
2. At Attention	*75*	*82*
3. Holding Breath	*78*	*82*
4. Deep Breathing	*62*	*72*
5. After Exercise	*78*	*90*

TABLE 2.

Tests	Average for Boys	Range High—Low	Average for Girls	Range High—Low	Class Average	Range High—Low
1. At Rest	*72*	*60–80*	*76*	*62–87*	*74*	*60–87*
2. At Attention	*75*	*65–85*	*78*	*70–93*	*77*	*65–93*
3. Holding Breath	*78*	*70–80*	*82*	*80–85*	*80*	*70–85*
4. Deep Breathing	*63*	*58–67*	*68*	*60–73*	*66*	*58–73*
5. After Exercise	*80*	*72–83*	*87*	*78–90*	*84*	*72–90*

Activity 12. REFLEX ACTION IN PEOPLE, pp. 69-72

Purpose

The purpose of this activity is to observe some simple inherited reflex actions. Students will assume both the role of experimenter and the role of subject. They will become aware of the involuntary aspect of a reflex action as they experience their own inability to block some reflex actions.

Processes Utilized

Observing, comparing, recording, predicting, inferring, experimenting

Preparation

Your students may use a door with a windowpane, if one is available, instead of the sheet of clear plastic to protect the eyes during the blink-reflex test. The subject should stand on one side of the door and the experimenter on the other side.

For the pupillary-reflex test, devise some means to provide a real contrast of dark and light in the room, since results will depend on a difference in the amount of light reaching the eyes.

Since students will use medicine droppers to place a 1-percent acetic acid solution in their mouth, make sure that the medicine droppers are clean. To make a 1-percent solution of acetic acid, pour 1 mL of acetic acid into a graduated cylinder. Fill the graduated cylinder to the 100-mL mark with tap water. (If you use vinegar to make the 1-percent acetic acid solution, mix 10 mL of vinegar with 40 mL of water.) Cover and store the 1-percent solution in a clean flask and label the flask.

Data Collected

A sample of a student's response to the tests for inherited reflex behavior is shown in the table at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. (PA) No, the subject was not able to prevent the knee-jerk reflex by exerting willpower. This reflex action is characterized by a stimulus-response arc that passes through the spinal cord and bypasses the brain. In order for the subject to be able to prevent a response, the brain would have to be in control of the response.

2. (PA) The knee-jerk response was not affected at all by the subject's effort to prevent the knee from jerking by exerting willpower.

3. (PA) The subject was able to prevent the blink response to a degree because some of the muscles controlling the eyelids can be contracted to hold the eyelids open by force.

4. (PA) The blink reflex protects people's eyes from unexpected approaching objects.

5. (PA) The pupils become smaller to reduce the amount of light entering the eye.

6. (PA) Reflex closing of the pupils generally prevents injury to the eye from too much radiation.

7. (PA) No, the shaded eye remained unchanged. The light affected only the illuminated eye because light is the stimulus that causes the muscles of the iris to contract.

8. (PA) The acetic acid solution seemed to cause the saliva to flow in great amounts.

9. (PA) The salivary reflex might be of value to people as an aid to digestion. More saliva means more digestive juices in the mouth.

Kind of Reflex	Nature of Response
1. Knee-jerk Reflex	a. *The foot kicks forward.*
	b. *The foot kicks forward.*
	c. *The foot kicks forward.*
2. Blink Reflex	a. *The eyelids close.*
	b. *The eyelids partially close.*
3. Pupillary Reflex	a. *The pupils become smaller.*
	b. *The pupils enlarge as the student looks at the dark spot, then become smaller as the student looks at a lighted area.*
	c. *The pupil in the nonilluminated eye becomes smaller as the student turns toward the light.*
4. Salivation Reflex	*The saliva flows in great amounts.*

Activity 13. THE SENSE OF TASTE, pp. 73-74

Purpose

The purpose of this activity is to help the students discover that different parts of the tongue are sensitive to different tastes.

Processes Utilized

Observing, comparing, recording using space-time relationships, inferring

Preparation

Be sure to have at least 4 cotton swabs for each student so that each student uses only his or her own swabs.

Several dilute solutions of chemicals should be prepared ahead of time by you or a student assistant. To prepare the 1-percent NaCl (salt) sollution, dissolve 1 g of salt in 99 mL of distilled water. Store the salt solution in a clean beaker. Label the beaker.

To prepare the 5-percent sugar solution, dissolve 5 g of sugar in 95 mL of distilled water. Label and store the sugar solution.

Use the kind of vinegar called white vinegar instead of wine vinegar or cider vinegar.

To prepare the 0.001-percent quinine solution, obtain a capsule of quinine sulphate from a drugstore and dissolve the capsule in 1 L of warm, distilled water. (Some particles may not dissolve, since this capsule will more than saturate the litre of water.) Using a clean graduated cylinder, measure out 30 mL of quinine solution and then mix these 30 mL with 970 mL of distilled water. The resulting solution is about 0.001 percent quinine. Store the 0.001-percent quinine solution in a clean container and label it.

Data Collected

Samples of data that students might obtain are shown in the table at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. Students' answers will vary according to their data. (PA) The test solutions were tasted on all areas of the tongue, but some areas tasted certain chemicals more strongly than other areas.
2. Students' answers will vary according to their data. (PA) The test solutions were tasted on all areas of the tongue, but some areas tasted certain chemicals more strongly than other areas.
3. Students' answers will vary according to their data. (PA) Both people tasted the same solution on the same area of their tongue, so their taste buds must be distributed in the same way.
4. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Test Solution	Person Being Tested	Response			
		Tip	Center	Back	Sides
Salt Water	First Person	*Strong*	*Mild*	*Weak*	*Mild*
	Second Person	*Strong*	*Weak*	*Weak*	*Weak*
Sugar Water	First Person	*Strong*	*Mild*	*Weak*	*Weak*
	Second Person	*Strong*	*Weak*	*Weak*	*Weak*
Vinegar	First Person	*Weak*	*Mild*	*Weak*	*Strong*
	Second Person	*Weak*	*Weak*	*Weak*	*Strong*
Quinine	First Person	*Weak*	*Mild*	*Strong*	*Weak*
	Second Person	*Weak*	*Weak*	*Strong*	*Weak*

EXPLORING EARTH AND SPACE

Activity 1. THE IRREGULAR SHAPE OF THE EARTH, pp. 75-76

Purpose

The purpose of this activity is to help the students become aware that the earth has an irregular shape. That is, it is not a perfect sphere. Technically, the earth is said to be an oblate spheroid. Some possible reasons for its shape are explored in this activity.

Processes Utilized

Observing, comparing, inferring, recording, measuring

Preparation

Try to have at least two or three globes on hand so that the students can work in small groups for Part 1. For Part 2, make sure the paper the students use is fairly thin. If it is too thick or stiff, the results will not be as noticeable.

Answers to Activity Review: Part 1

1. (PA) The piece of tape near the North Pole was easier to read because the one at the equator was moving too fast.
2. (PA) The speed of rotation of the earth is fastest at the equator and slowest at the poles.

Answers to Activity Review: Part 2

1. (PA) The "earth" is not a perfect circle anymore. It is shorter from "pole" to "pole" than at the "equator."
2. (PA) The force from the rotation of the earth causes the earth to have an irregular shape. It is slightly flattened at the poles and bulges slightly at the equator.

89 Activity 2. THE GREENHOUSE EFFECT, pp. 77-80

Purpose

The purpose of this activity is to help students realize how the greenhouse effect takes place and to try to determine what materials could be used effectively in demonstrating the greenhouse effect.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, inferring, interpreting data, controlling variables

Preparation

Several days before beginning this activity, ask your students to bring in shoe boxes and different kinds of transparent materials. You will need to supply an infrared lamp and three thermometers for every group doing the activity. If you do not have enough lamps or thermometers, have your students take turns doing the activity. You may also want to have several types of glass available for students to try.

Data Collected: Part 1

Typical data indicating the steady temperature and the temperature change for the materials used are shown in Table 1.

TABLE 1.

Transparent Material	Steady Temperature	Temperature Change
1. Control	*38°C*	*None*
2. Glass	*35°C*	*−3°C*
3. Food wrap	*33°C*	*−5°C*
4. (Student's choice)		
5. (Student's choice)		

Answers to Activity Review: Part 1

1. (PA) The temperature shown by the thermometer went down when a transparent material was placed between the heat lamp and the thermometer.
2. Answers to this question will vary depending upon the kinds of transparent materials placed between the heat lamp and the thermometer. The more transparent the material, the higher the temperature.

3. (PA) Glass had the least effect on the temperature when it was placed between the heat lamp and the thermometer.

4. (PA) If a material that did not allow infrared radiation to pass through it were placed between the heat lamp and the thermometer, the temperature would fall until the temperature of the room was reached.

5. (PA) The amount of infrared radiation that was allowed to pass through the material to reach the thermometer if the temperature became very high would be very great.

6. (PA) The amount of infrared radiation that was allowed to pass through the material to reach the thermometer if the temperature stayed close to room temperature would be very small.

Data Collected: Part 2

Examples of possible data the students might record for the temperature in the boxes are shown in Table 2.

Answers to Activity Review: Part 2

1. (PA) The highest temperature was in Box 1, the box with the most transparent material covering it.

TABLE 2.

Box in Sunlight	Steady Temperature
Box 1—Most-Transparent Material	*42° C*
Box 2—Least-Transparent Material	*39° C*
Box 3—Uncovered	*35° C*

2. (PA) The lowest temperature was in Box 3, the box that was uncovered.

3. (PA) The temperature in the box that was not covered did not change.

4. (PA) The transparent material either did not allow the long-wave radiation to get out or the transparent material prevented the heated air from escaping.

5. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 3. THE ANEMOMETER, pp. 81-84

Purpose

The purpose of this activity is to enable students to construct a simple anemometer for weather observations and to help students realize how wind conditions can change over a short period of time.

Processes Utilized

Observing, comparing, recording, measuring, using space-time relationships, inferring

Preparation

You may wish to purchase three 1 cm dowels from a hardware store or lumberyard. Ask your students to bring in paper cups, tacks, finishing nails, wood screws, and a large flat board. You may also be able to obtain the materials needed and borrow drills, hammers, and screwdrivers from the industrial-arts department in your school. You might want to have groups of two or three students build the anemometers in class. Or you might want to build one or two anemometers in class and then have some students build them at home if they wish.

Data Collected

Possible data indicating the number of turns, the wind speed, and the general weather conditions from hour to hour are shown in the tables at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. Answers to this question will vary depending upon the type of day it is.

2. Answers to this question will vary depending upon the type of day it is.

3. Answers to this question will vary depending upon the weather during each of the two days.

4. Answers to this question will vary depending upon the overall weather during the first day.

5. Answers to this question will vary depending upon the overall weather during the second day.

6. (PA) Wind speed seems to have a great deal to do with how the weather changes from hour to hour and from day to day. The wind does not stay at the same speed from hour to hour or from day to day nor do the general weather conditions stay the same.

7. (PA) Weather observations should include more than just a measurement of the wind speed and observations of general weather conditions because these observations may not be enough for trying to predict how the weather will change.

8. (PA) The student's response to this question will depend to some extent on how well his or her anemometer is constructed.

TABLE 1.

First Day	Hour 1	Hour 2	Hour 3	Hour 4
Number of Turns	*35*	*32*	*22*	*25*
Wind Speed (km/h)	*10*	*9.1*	*6.3*	*7.1*
General Weather Conditions	*Clear*	*Clear*	*Clear*	*Clear*

TABLE 2.

Second Day	Hour 1	Hour 2	Hour 3	Hour 4
Number of Turns	*30*	*25*	*20*	*15*
Wind Speed (km/h)	*8.6*	*7.1*	*5.7*	*4.3*
General Weather Conditions	*Clear*	*Few clouds*	*Scattered clouds*	*Partly cloudy*

Activity 4. THE HAIR HYGROMETER, pp. 85-88

Purpose

The purpose of this activity is to enable students to construct a hygrometer for weather observations and to help students realize how the humidity of the air can change over a period of time.

Processes Utilized

Observing, comparing, recording, using numbers, using space-time relationships, inferring

Preparation

You may wish to ask your student to bring in milk cartons and needles from home. If milk cartons are not generally available to your students, have some students use shoe boxes. If a shoe box is used, merely take the top off the box, turn it upside down, and cut an H in the bottom of the shoe box. You might want to make the first hygrometer yourself and then have students use the one you made as a model.

Answers to Activity Review: Part 1

1. (PA) A small turn of the needle may make the pointer move several numerals over on the scale.

2. (PA) It was necessary to set the pointer to the numeral 10 because the numeral 10 represents the maximum humidity of the air (near 100%).

Data Collected: Part 2

Typical data that might be obtained for the relative humidity using the hair hygrometer are given in the table at the end of the teacher's manual material for this activity.

Answers to Activity Review: Part 2

1. (PA) The reading was highest on the wet day.

2. (PA) The reading was lowest on the dry day.

3. (PA) Answers will vary according to the relative humidity on the days on which the readings were taken.

4. (PA) The hair was longer on a day with high humidity because as the hair becomes a little bit longer, it causes the pointer to move toward the higher numerals on the scale.

5. (PA) Answers will vary according to the sensitivity of the students' hygrometers.

6. (PA) The hair hygrometer could be made more accurate by also finding the low end of the scale. If nearly all the moisture in the air could be removed by an air conditioner or a dehumidifier, the position of the pointer in the dry air could be indicated as 0 or 1. Then the remainder of the scale could be drawn carefully so that there will be equal increments between the highest humidity and the lowest humidity.

7. Each student's answer will depend upon the expected outcome at the beginning of the activity.

	First Reading	Second Reading	Third Reading	Weather Conditions
First Day	*5*	*5*	*6*	*Partly cloudy, warm*
Dry Day	*2*	*2*	*3*	*Clear and cold*
Wet Day	*8*	*8*	*8*	*Cloudy and rainy*

Activity 5. THE NEPHOSCOPE, pp. 89-92

Purpose

The purpose of this activity is to enable students to construct a nephoscope for cloud observations and to help students realize how clouds change in speed and direction over a period of time.

Processes Utilized

Observing, comparing, recording, using numbers, using space-time relationships, inferring

Preparation

Several days before beginning this investigation, ask your students to bring in circular mirrors, pieces of dowel, and flat boards. Mirrors about 15 cm in diameter are ideal. You may be able to obtain the dowel and flat boards from an industrial-arts department in your school district. You may also borrow some saws from an industrial-arts department for sawing the dowel to the correct length. The reason for making the dowel equal to half the diameter (or radius) of the mirror is that the formula for calculating the speed of a cloud is

$$\text{Speed} = \frac{\text{cloud height (metres)} \times \text{mirror radius.}}{\text{height of dowel} \times \text{time (seconds)}}$$

If the radius of the mirror and the height of the dowel are the same, these components of the formula will cancel out so that

$$\text{Speed} = \frac{\text{cloud height (metres).}}{\text{time (seconds)}}$$

You may wish to have some students use dowels that are not equal to the radius of the mirror and use the full formula to calculate the speed of the clouds.

Data Collected

Examples of possible data the students might record for the cloud height, time, speed, and direction are shown at the end of the teacher's manual material for this activity.

Answers to Activity Review

1. Answers will vary according to the types of clouds that move over your area. However, students should note that the cloud cover may vary from hour to hour or from day to day.

2. (PA) High clouds move faster than low clouds move.

3. Answers will vary according to the types of clouds that moved over your area during the time that the observations were made.

4. Answers will vary according to the types of clouds that moved over your area.

5. Answers will vary according to the types of clouds that moved over your area.

6. (PA) The higher the clouds are, the faster the speed of the clouds. The lower the clouds are, the slower the speed of the clouds.

7. Answers will vary according to the area where you live and the types of clouds that pass overhead.

8. (PA) The nephoscope had to be oriented in a north-south direction with the south end pointing north so that the direction of the wind could be determined easily. The mark at which the cloud reaches the edge would indicate right away what direction the wind came from, not what direction it was blowing toward.

9. (PA) More-accurate observations could be obtained if the height of the clouds could be known with greater certainty. (Other answers students may have would probably have to do with the construction of the nephoscope itself.)

10. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Trial	Height (metres)	Time (seconds)	Speed (m/s)	Direction
1	*2 000*	*266*	*7.5*	*W*
2	*2 000*	*259*	*7.7*	*W*
3	*2 000*	*267*	*7.5*	*W*
4	*500*	*246*	*2.0*	*SW*
5	*500*	*249*	*2.0*	*SW*
6	*2 000*	*277*	*7.2*	*W*

Activity 6. MEASURING RAINFALL, pp. 93-96

Purpose

The purpose of this activity is to have students observe how the amount of precipitation compares over the same general area.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, using space-time relationships, inferring

Preparation

You may want to involve the whole class in taking measurements of precipitation. If so, make sure that cans of the same size are used by everyone. You may wish to have your students make a map showing the numbers and locations of the stations. Then you could have your students make a line graph showing each station on the x-axis and the amount of rainfall on the y-axis. The different storms could be indicated by different colors so the students can see at a glance how the amounts of precipitation vary from station to station and from storm to storm.

Data Collected

The data that students record in the table will depend upon the amount of precipitation received in the area that they studied.

Answers to Activity Review

1. (PA) Yes, there were differences among the stations. More rain appeared to fall in one part of the area being measured than in the other parts.

2. (PA) No, one station is not enough to show how much precipitation an area receives. It just gives a general idea of the amount received.

3. The answers to this question will vary. However, most students would probably report that the stations in one part of the area tended to receive more precipitation than the remaining stations in the area.

4. The answers to this question will vary. However, most students will probably give one of the three reasons for differences in precipitation that are given in the background information for this activity.

5. (PA) Rain gauges could be used at each station for measuring the precipitation.

6. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 7. MICROCLIMATES, pp. 97-98

Purpose

The purpose of this activity is to help students understand the meaning of "microclimate" and to help them realize that there may be some differences in climate within a particular climatic zone.

Processes Utilized

Observing, comparing, recording, measuring, inferring

Preparation

If certain microclimates are not accessible to most of your students, you might want to take your class on a field trip to visit those microclimates. You might also have your students get information about certain microclimates by listening to weather broadcasts. For example, a broadcast will often give weather information from two or three reporting areas. One of those areas may have a different microclimate than the other.

When your students take measurements, you may want to have them use barometers if the barometers are sensitive enough and not too difficult to transport. You may also want to have your students use a wind vane if they can transport it easily.

Answers to Activity Review

1. Just how the microclimate in a wooded area compares to an open area nearby depends on the season and the general weather conditions. In general, the wooded area will be cooler and more humid in the summer and have less wind speed than the open area. In the winter the wooded area will be warmer and have less wind speed than the open area.

2. Just how the microclimate near the water compares to an inland area depends on the season and the general weather conditions. In general, the microclimate near the water will be cooler in the summer and often warmer than the inland area in the winter.

3. Just how the microclimate on a city street compares to the microclimate in the countryside depends on the season and the general weather conditions. In general, city air is drier and warmer than the air in the countryside.

4. Just how the microclimate on a hill compares to the microclimate in a low area depends on the season and the general weather conditions. In general, the higher area will have a lower temperature and humidity (but a higher wind speed) than the lower area.

5. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 8. WARM WATER MEETS COLD WATER, pp. 99-100

Purpose

The purpose of Activity 8 is to have students study differences in water density by observing the layering that occurs when warm water comes in contact with cold water, and when cold water comes in contact with warm water.

Processes Utilized

Observing, comparing, recording, using space-time relationships, inferring

Preparation

The warm water used in the activity should not be

so hot as to burn one's hand. Very cold water can be obtained by allowing ice cubes to melt in tap water.

Remind the students that the water in the jar must be undisturbed. Slow, careful removal of the bottle cap will reduce the chance of making currents in the jar of water.

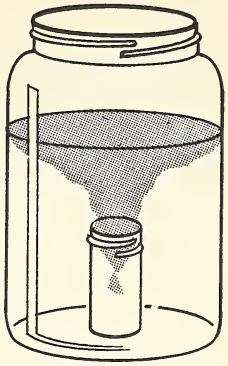
Data Collected

The sketches shown here are examples of how students might draw their observations of warm water in cold water, and cold water in warm water.

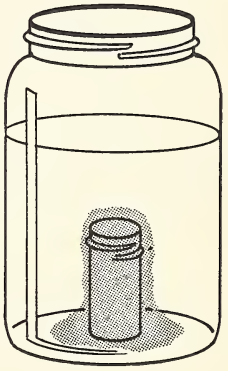
Answers to Activity Review

1. (PA) When the cap was removed from the bottle of warm water, the warm water slowly moved up and out of the bottle. The warm water rose to the survace of the cold water and spread out at the surface.
2. (PA) When the cap was removed from the bottle of cold water, the cold water remained inside the bottle. What little cold water moved out of the bottle sank to the bottom of the jar and became mixed with the warm water.
3. (PA) If the bottle of warm water were opened at the top of the jar of cold water, the warm water would stay near the surface of the cold water and slowly spread out over the surface of the cold water.
4. (PA) If the bottle of cold water were opened at the top of the jar of warm water, the cold water would sink to the bottom of the jar and spread out at the bottom of the jar.
5. (PA) The results of this activity seem to suggest that water of a certain temperature will tend to rise or sink in a body of water. The water will rise if it is warmer than the body of water. The water will sink if it is colder than the body of water.

Warm Water in Cold Water



Cold Water in Warm Water



Activity 9. CHEMICAL WATER SOFTENERS, pp. 101-102

Purpose

The purpose of Activity 9 is to have students discover in what way a chemical water softener affects water's ability to form suds.

Processes Utilized

Observing, comparing, classifying, recording, measuring, using space-time relationships, inferring

Preparation

You may wish to make up the soap solution before the students do this activity. One way to do this would be to dissolve a large bar of soap in 4 L of water. This amount of soap solution should be enough for the use of one or two classes.

You may also wish to make available for the students samples of water from various sources. Perhaps you may wish to make available certain samples that are not easily accessible. Some examples of the various sources of water are streams, rivers, lakes, wells, ponds, ditches, rain barrels, and so on.

Washing soda is also called sal soda.

Data Collected

Data that students might record will vary depending on sizes of samples, types of water, and strength of the soap solution. However, distilled water should require less soap and thus be softer than any other sample.

Answers to Activity Review

1. (PA) The sample of water that seemed to be the softest was the sample of distilled water. (The answer to the question about the sample of water that seemed to be the hardest will vary depending on the samples used.)

2. Answers will vary depending on samples used, but distilled water will be the softest.

3. (PA) The method I used in this activity is a way of determining the relative hardness of water because this method simply indicates the number of drops of soap that are needed to overcome the hardness in each sample.

4. (PA) After the samples were treated with a water softener, the number of drops of soap solution required to form suds was less for each of these samples, except for distilled water, in which there was no difference.

5. (PA) After the water softener was added, the minerals causing hardness were removed or changed, making the water softer, or less hard. As a result, fewer drops of soap solution were required to form suds.

Activity 10. PERMEABILITY, pp. 103-104

Purpose

The purpose of Activity 10 is to have students determine what effect the different-sized materials that make up soil, gravel, and rock have on the movement of groundwater through soil, gravel, and rock.

Processes Utilized

Observing, comparing, recording, using numbers, measuring, inferring

Preparation

The diameter or length of the glass column to be used in this activity is probably not as important as its capacity for holding 300 mL of water when the column is filled with marbles, BBs, or sand. Also, you may wish to have your students use two burette clamps instead of one in order to be certain that the glass column is firmly attached to the ring stand.

Remind your students to be very careful when attaching the glass-column cap. If the cap is too loose, water might leak out or the cap might fall off, permitting the marbles, BBs, or sand to spill from the column.

If water tends to leak through the rubber hose after being clamped with the rubber-hose clamp, first fold the rubber hose over and clamp the hose together at the folded part.

Data Collected

Examples of data that students might obtain for the permeability of the three materials are shown in the following table.

Materials	Time Required for Water to Drain
Marbles	*3 s*
BBs	*5 s*
Sand	*7 s*

Answers to Activity Review

1. (PA) The marbles allowed water to pass through most rapidly.

2. (PA) The marbles had the greatest permeability.

3. (PA) After comparing the permeabilities for the three materials, I would say that the greater the size of the materials, the greater the permeability.

4. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 11. EXPLORE THE BOTTOM OF A "MYSTERY" CONTAINER, pp. 105-108

Purpose

The purpose of Activity 11 is to have students determine the nature of the bottom of a "body of water" through indirect means.

Processes Utilized

Observing, recording, using numbers, measuring, using space-time relationships, communicating, inferring

Preparation

The containers for this activity should be 4-L tin cans prepared, numbered, and labeled by you at least the day before the students are to use them. To prepare the cans, add plaster of paris to water until a medium paste is formed. You will need about 1.5 kg of plaster of paris to prepare six cans. You may wish to make six different structures in the cans. For example, you could prepare a slanted bottom, a stepped bottom, a cube at the bottom, a ridge at the bottom, a drop-off bottom, and a raised bottom with a hole in the centre. Use cardboard to help form these structures. Label the four sides of each container *north, south, east,* and *west.* See the illustrations at the end of the teacher's manual material for this activity.

The hardware cloth may be purchased locally at a hardware store. The openings should be at least 1 cm. The hardware cloth should be cut into squares that fit on the top of the containers. Sharp edges and corners should be bent over or covered with tape to prevent injuries.

Lead fishing weights small enough to fit through the openings in the hardware cloth may be purchased at a local sport shop or sporting-goods store.

Add a few drops of dark food coloring to the water in the container to keep the bottom of the container from being seen. The students should not reach into the can or pour out the water.

Data Collected

The data that students record will vary with the container used. Some possible three-dimensional or perspective views are shown on the following page.

Answers to Activity Review

1. Answers will depend upon which container the students used in this activity.
2. Answers will depend upon which container the students used in this activity.
3. Answers will depend upon which container the students used in this activity.
4. Answers will vary. However, the relatively few determinations with the depth finder and the fact that it was used in only two directions leaves more area of the bottom unknown than known. (PA) My idea of what the bottom looks like could be improved by using the depth finder until the entire bottom would be tested.
5. (PA) A line and a weight would not be practical for large, deep bodies of water because the line would have to be very long, currents would cause the line to move and give incorrect readings, and this method would be too slow in very deep water.
6. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

Activity 12. WAVES AND BEACHES, pp. 109-112

Purpose

The purpose of this activity is to help students find out more about the way waves act on beaches and to help them find out about one way in which the erosion of beaches can be controlled.

Processes Utilized

Observing, comparing, measuring, communicating, inferring

Preparation

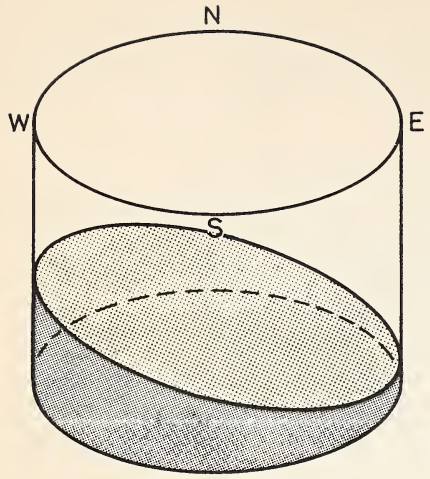
For the containers needed, you could have students bring in large laundry tubs if they have them at home. Or you could use a stream table for this activity if one is available in your school. You may wish to have students bring the pieces of wood that you need from home. You will also need a large quantity of sand. Plain sand is often available from building materials centers, but colored sand is usually available in pet stores or in large department stores.

Data Collected

The three diagrams of the beach that students draw will depend on the conatiner used, the sizes of the pieces of wood that are used, and the size of the waves that are created.

Answers to Activity Review

1. (PA) The waves that came in parallel to the beach moved some of the sand into the water.
2. (PA) The waves that came in at an angle to the beach caused some of the colored sand and some of the other sand to move into the water, but these waves also caused colored sand and other sand to move along the beach in the direction that the waves moved. The rows of colored sand became curved in the direction that the waves moved. (The curving of the rows should be shown in the students' diagrams.)
3. (PA) The waves that came in at an angle to the beach caused more erosion of the beach than the waves that came in parallel. Waves that came in at an angle caused more erosion because they either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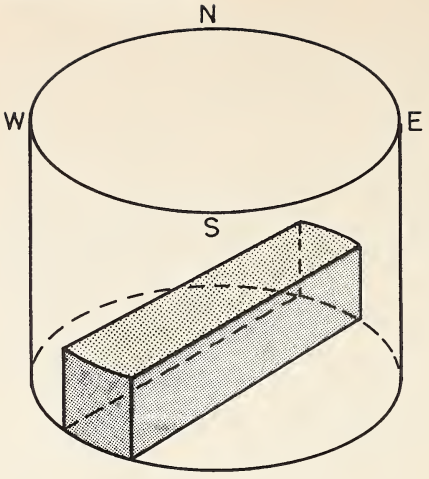
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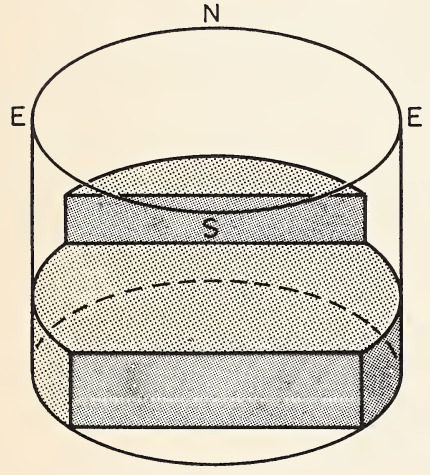
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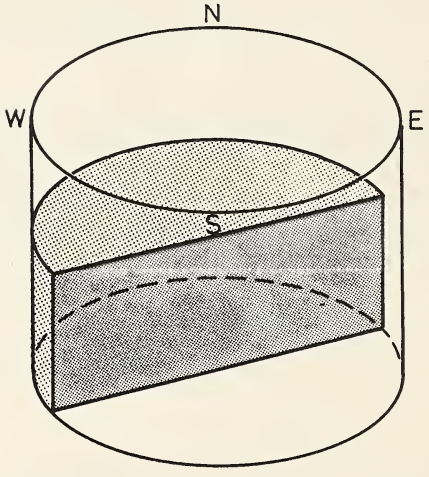
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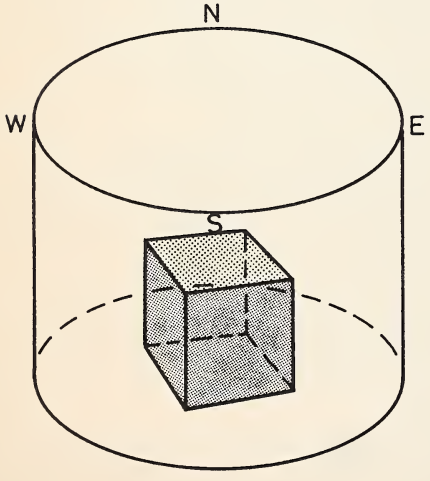
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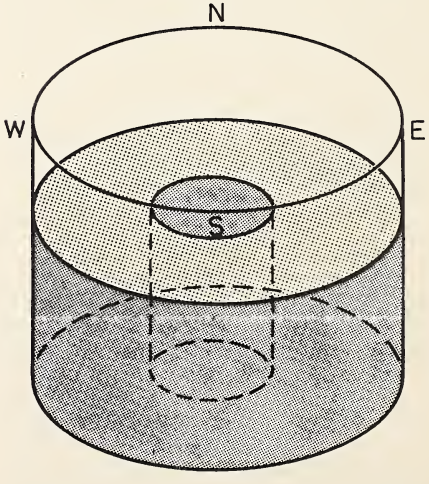
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moved sand into the water or moved sand along the shoreline.

4. (PA) The colored sand did not move as a result of placing pieces of wood into the beach. However, some of the colored sand was covered by sand that was moved on top of it. In general, the pieces of wood seem to stop the erosion of the beach.

5. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 13. SURFACE CURRENTS, pp. 113-114

Purpose

The purpose of this activity is to make students aware of how surface currents move and how they are affected by the shoreline.

Processes Utilized

Observing, using space-time relationships, inferring

Answers to Activity Review

1. (PA) The current of water moved in the same direction to the other side of the container as the direction of the airflow created by the fan.

2. (PA) Most of the colored water moved to the bottom of the container. It then moved back toward the fan and returned to the surface near the fan.

3. (PA) After the fan had been moved and turned on, the current of water behaved in the same way that it did before except that the current now flowed in a new direction (in the direction the fan was now blowing). The colored water moved to the bottom, moved back toward the fan, and returned to the surface near the fan as before.

4. (PA) When the fan was blowing along one side of the container, currents of water that moved along the side of the container were created. Most of the water changed direction when it came to the corner of the container, but some of it moved to the bottom of the container.

5. (PA) I think that a surface current that moved directly toward the shore would behave in a similar manner to the current of water in the closed container. It would move almost to the shore and then turn and move along the bottom of the ocean in the direction from which it came.

6. (PA) I think that a surface current that moved along the shore would behave in a similar manner to the current of water in the closed container. It would move along the shore until it encountered a land obstacle. Then it would change its direction, as the current of water in the closed container did.

7. The student's response will depend upon the expected outcome stated at the beginning of the activity.

Activity 14. RECOGNIZING SOME CONSTELLATIONS, pp. 115-122

Purpose

The purpose of this activity is to have the students recognize certain constellations and first-magnitude stars in the sky.

Processes Utilized

Observing, comparing, using space-time relationships

Preparation

Before beginning this activity, have the students discuss any night sky-watching activities they have engaged in. Make available those references in which the students can do research on the mythological characters that the constellations were named to honor. Have them become familiar with the constellations in the classroom so that when they go outdoors to study the constellations, their efforts will be more productive. You may wish to assign Part 2 of this activity as a homework exercise, since it must be done at night. Tell the students to pick a clear night.

Data Collected

Examples of possible data that students might record are given in the table at the end of the teacher's manual material for this activity.

Answers to Activity Review: Part 1

1. (PA) Orion has two first-magnitude stars, Rigel and Betelgeuse.

2. (PA) Fomalhaut and Canopus seem not to be part of a constellation. (The sky maps in this activity were made for latitudes north of 40° N. Fomalhaut is a part of the Southern Fish, and Canopus is a part of Argo, both of which can be seen south of 40° N latitude.)

Answers to Activity Review: Part 2

1. Answers will vary depending on which season of the year the students are sky watching.
2. Answers will vary depending on which season of the year the students are sky watching.

Brightest Stars			
Star	Constellation	Star	Constellation
Pollux	*Gemini*	*Altair*	*Aquila*
Betelgeuse	*Orion*	*Procyon*	*Canis Minor*
Rigel	*Orion*	*Sirius*	*Canis Major*
Aldebaran	*Taurus*	*Canopus*	*(Argo)*
Capella	*Auriga*	*Antares*	*Scorpius*
Fomalhaut	*(the Southern Fish)*	*Spica*	*Virgo*
Deneb	*Cygnus*	*Arcturus*	*Bootes*
Vega	*Lyra*	*Regulus*	*Leo*

Activity 15. MAKING A MODEL OF A RADIO TELESCOPE, pp. 123-126

Purpose

The purpose of this activity is to enable the students to understand some things about how a radio telescope works.

Processes Utilized

Observing, comparing, recording, communicating, inferring, experimenting

Preparation

Tell the students a week in advance that they will need a transistor radio and an umbrella. This will provide them with ample time to locate or borrow these things for the activity.

Data Collected

The data will vary according to the radio stations that can be picked up in the area.

Answers to Activity Review

1. (PA) The signals improve when the radio is turned toward the transmitting station.
2. (PA) The reflector collects and focuses certain radio signals when the reflector and the radio are turned toward the transmitting station.
3. (PA) The reflector blocks the radio signal when the reflector is placed between the transmitting station and the radio receiver.
4. (PA) When the reflector blocks out some of the signals transmitted from the earth, the weak signals from outer space can be identified.
5. (PA) The umbrella without the foil has no effect on the radio signals.
6. (PA) A larger umbrella might help me to get a stronger signal.
7. Each student's response will depend upon the expected outcome stated at the beginning of the activity.

Purpose

The purpose of this activity is to enable students to observe what factors affect the apparent brightness of a light source.

Processes Utilized

Observing, comparing, recording, inferring, measuring, using space-time relationships, communicating

Preparation

If you are not able to darken your classroom for this activity, plan in advance to reserve a dark room. Since the students may have several different kinds of light meters, you may wish to suggest that a meter with a numbered scale for reading light intensity is preferable for this activity.

Data Collected

1. Table 1. The data will vary depending on the kind of light meter that is used. What is important is that each student's data show that the meter reading has a higher relative value when the light source is brighter.

2. Table 2. The data will vary but should reflect that the meter reading decreases as the distance from the light source increases.

Answers to Activity Review

1. (PA) Different light sources give off different amounts of light.

2. (PA) As the distance from the 100 W light bulb increased, the light-meter reading decreased.

3. (PA) Yes, a dim light source can cause a greater light-meter reading than a bright light source if the dim light source is closer to the light meter.

4. Each student's answer will depend upon the expected outcome stated at the beginning of the activity.

MATERIALS

The materials needed to conduct the activities in this manual are listed below in alphabetical order to provide a reference for the teacher. The number or numbers following each item of material indicate the activity or activities in which the material is needed.

The list may be useful to the teacher (1) in requisitioning supplies, (2) in finding a specific description of how an item of material is to be used, and (3) in determining quantities of material needed for a specific activity.

EXPLORING MATTER AND ENERGY

A

Alcohol: 2, 3
Apple: 1

B

Balance, triple-beam and/or two-platform: 3, 8
Beakers, assorted sizes: 10
Blindfold: 1
Brick: 6

C

Candy: 1
Catch bucket: 4
Chalk: 7
Charcoal: 10
Coat hanger, wire: 8
Cola drink, nondiet: 1
Copper sulphate, anhydrous: 2
Cotton: 10

D

Dishpan, plastic: 1

F

Fan, electric: 8
File folder: 8
Funnel: 10

G

Graduated cylinder: 3, 4
Gravel: 10

I

Ice: 1
Iron, piece of: 4

M

Medicine ball: 7
Medicine dropper: 2
Metre stick: 3, 7, 8
Microscope: 2
Microscope slides: 2

O

Orange juice: 1
Overflow can: 4

P

Plaster of paris: 2

R

Ring stand and ring: 10
Rock: 3

Roller skates: 7
Ruler, metric: 1

S

Salt, table (sodium chloride): 2
Sand: 10
Spring scale: 4, 6
Straw, drinking: 8
String: 4, 6
Sugar: 2

W

Watch glass: 2
Wire cutter: 8
Wood, balsa: 8
Wooden block, regular-shaped: 3, 4

EXPLORING LIVING THINGS

A

Acetic acid solution (vinegar): 12
Ant, wingless queen: 6
Ant, worker: 6
Ant farm: 6
Ant larvae: 6
Ant nest, earth from: 6
Ant pupae: 6

B

Beakers, assorted sizes: 9, 10
Beef, raw: 7

C

Calcium chloride: 5
Cardboard: 5, 12
Cheesecloth: 7
Coffee cans with clear lids: 5
Cornstarch: 9
Cotton: 5
Cotton swab: 13
Coverslip: 3

D

Debris, from ditch or pond: 3
Digger, dandelion: 2
Distilled water: 4, 8

E

Eggs, brine shrimp: 8

F

Fruit: 7

G

Glass square: 3
Graduated cylinder: 10

H

Hand lens: 8
Honey: 6

I

Index card: 4
Iodine solution: 9
Isopod: 5

J

Jar, large: 7

L

Light source: 5

M

Medicine dropper: 3, 9, 10, 12
Metre stick: 1
Metric ruler: 2

Microscope: 3
Microscope slide: 3
Mortar and pestle: 9
Mosquito: 7

N

Newspaper, small piece: 12

O

Orange juice: 9

P

Paper towel: 13
Pencil, glass-marking: 3, 8
Plastic, sheet of clear: 12
Pond water: 3, 7

Q

Quinine solution: 13

Refrigerator or ice chest: 8
Rock: 5

S

Salt, table (sodium chloride): 8, 13
Scalpel: 8
Stirring rod (glass): 9, 10
String, ball of: 2
Sugar solution: 13

T

Test tube: 8, 9
Testing materials for vitamin C (lemon juice, lime juice, grapefruit juice, green pepper, wheat-germ oil, Hi-C drink, Kool-Aid drink, milk, vitamin C tablet): 9
Test-tube rack: 8, 9
Thermometer: 8

V

Vinegar (acetic acid solution): 13

EXPLORING EARTH AND SPACE

A

Anemometer: 7
Astrolabe: 14

B

Beakers, assorted sizes: 10
Borax or washing soda: 9
Bottle, small, with corks or caps: 8, 9
Bristle from a long brush or broom: 4

C

Candle: 16
Cans, large and empty, same size: 6, 11
Cellophane, red: 14
Clamp, burette: 2, 10
Compass, magnetic: 5, 14
Copper BBs: 10
Cord: 15
Crucible tongs: 8
Cups, paper: 3

D

Dishpan, plastic: 12, 13
Dowel: 3, 5
Drill: 3

F

Fan, electric: 13
File, steel: 6
Fishing weight: 4
Flashlight: 14
Foil, heavy-duty aluminum: 15
Food coloring: 8, 13

G

Glass column: 10
Glass column cap with drain tube: 10
Globe, supported: 1
Glue: 4, 5
Graduated cylinder: 10

H

Hair, long: 4
Hammer: 3
Hardware cloth: 11
Heat lamp: 2

I

Index card: 4

J

Jar, large, widemouthed: 8

K

Knife: 4

L

Lead weight: 11
Light bulb, 40-watt and 100-watt: 16
Light bulb socket and cord: 16
Light meter: 16

M

Map (of city, county, or section): 6
Marble: 10
Medicine dropper: 9
Metre stick: 5, 6, 16
Metric ruler: 1, 11
Milk carton: 4
Mirror, circular: 5

N

Nails, assorted sizes: 3
Needle: 4
Newspaper: 12

P

Paint, black tempera: 2
Paper, notebook: 1
Paper clips, metal: 4, 11
Paper towel: 11
Pen, felt-tip: 4, 5
Pencil: 1
Pencil, glass-marking: 9
Psychrometer (or hair hygrometer): 7

R

Radio, small: 15
Ring stand: 2, 10
Rubber hose: 10
Rubber hose clamp: 10

S

Sand, clean: 10, 12
Sand, coloured: 12
Saw: 5
Screen: 10
Screwdriver: 3
Shoe box: 2
Soap, bar: 9
Sponge: 4

T

Tacks: 3, 4
Tape, cellophane: 4, 15
Tape, masking: 1, 5, 11, 16
Thermometer: 2, 7
Thread: 11
Towel, cloth: 4
Transparent materials (glass, food wrap, etc.): 2

U

Umbrella: 15

W

Watch (with second hand): 3, 5, 9
Water, distilled: 9
Water samples (spring, stream, river, lake, well, etc.): 9
Wax or grease: 3
Wood screw, flat-head: 3
Wooden blocks: 12
Wooden board: 3, 5

Name_____

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